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(54) Moulding tyres

(57) A method of making vehicle tyres comprises filling a pair of discrete annular tyre sidewall moulds 4 and 5 with uncured sidewall compound, Figure 2 (not shown), bringing the sidewall moulds 4 and 5 into contact one either side of a preshaped green tyre carcass, positioning the assembly of sidewall moulds 4 and 5 and tyre carcass in a tyre curing mould, curing the tyre and removing it from the curing mould and the sidewall moulds 4 and 5.

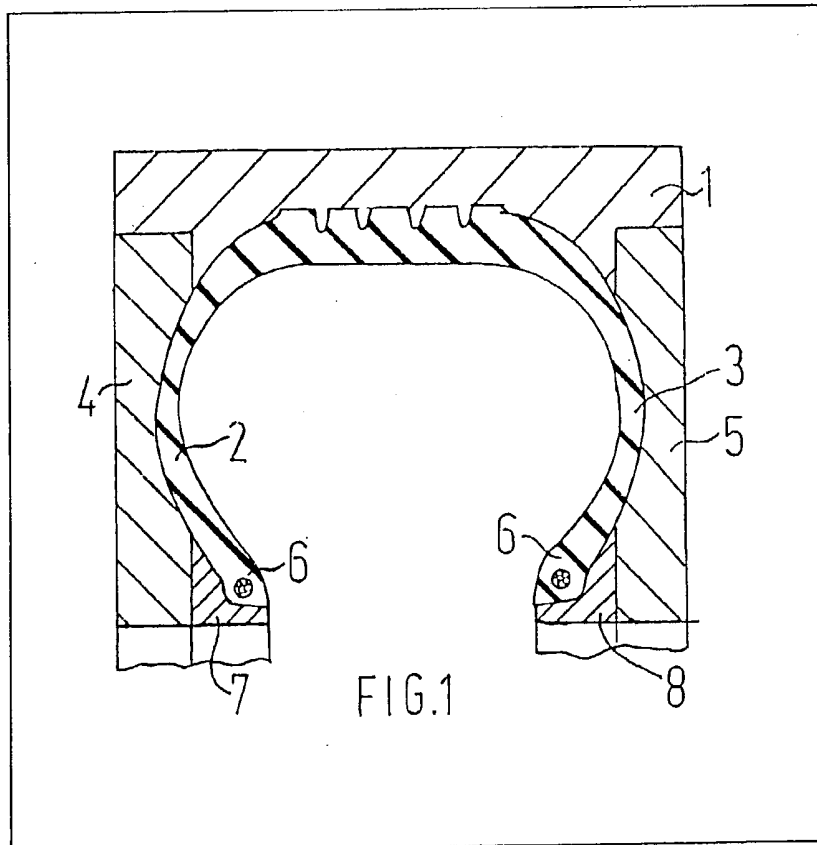
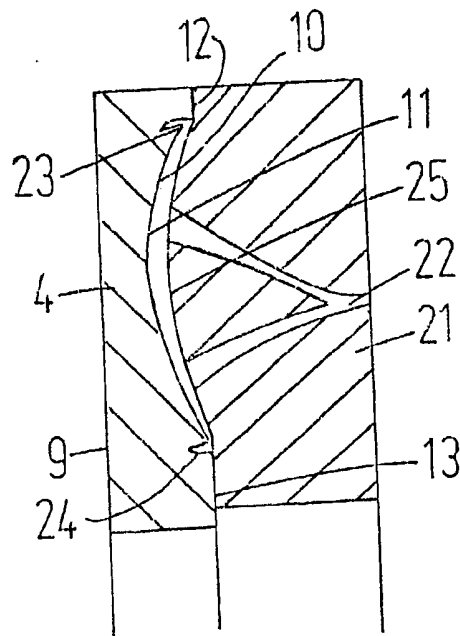
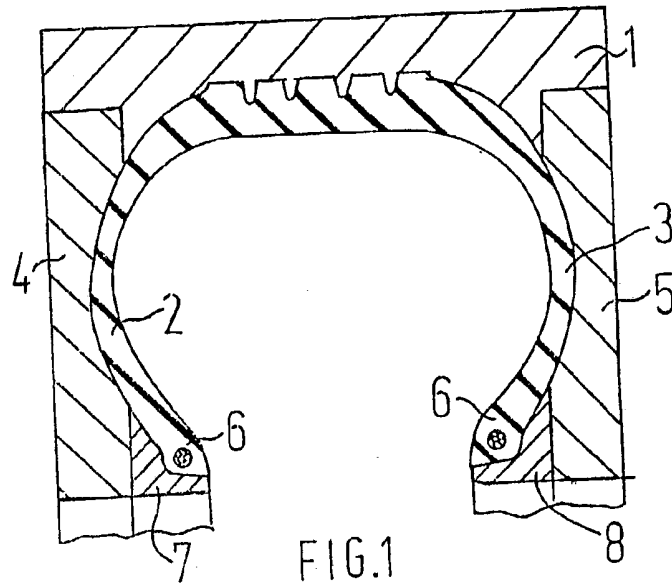


FIG.1

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FIG.2

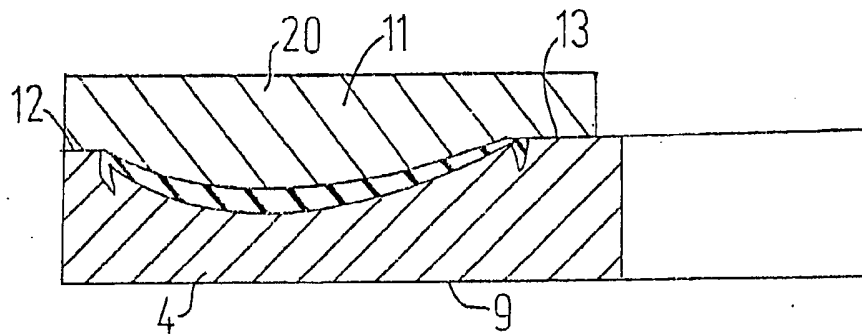
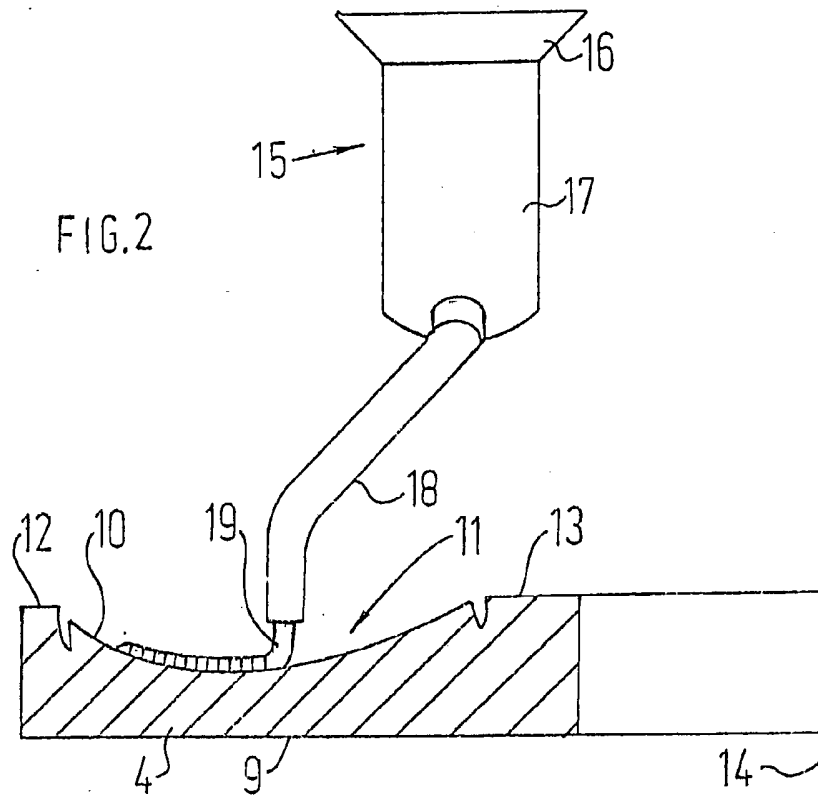


FIG.3

## SPECIFICATION

## Moulding of elastomeric material components

5 This invention relates to the moulding of elastomeric material components and in particular to the assembly and moulding of vehicle tyres.

Conventional tyre production processes assemble a plain completely unpatterned tyre known as a  
10 green tyre (because it is unvulcanised) which is then placed in the mould of a curing press which is closed to finally shape the tyre and impress the tyre tread pattern and the sidewall patterns upon the green carcass. The tyre is retained in the closed press until  
15 the heat of the press has effected vulcanisation. It is important that the final appearance of the tyre and particularly its sidewalls is good.

Difficulties occur in forming the tyre sidewalls in conventional shaping and curing processes due to the appreciable stretch at the radially outer edge  
20 when an extruded straight length of sidewall material is assembled to a flat built tyre carcass and then shaped up into a toroid. The shaping makes it particularly difficult to maintain the desired sidewall cross-sectional profile especially when the pre-  
25 extruded length of sidewall already includes variations in cross-section from its basic longitudinal extrusion process.

These problems have been overcome in proposals to cast tyres or to injection mould tyres by casting or  
30 injecting the sidewalls into a fully shaped toroidal mould but such systems invariably require complex supports for the carcass reinforcement or indeed the design of a tyre without a conventional carcass reinforcement.  
35

Nevertheless in the case of many tyres the sidewall appearance greatly affects the saleability of the product. Blemishes in the sidewall and, in the case of white sidewall or white lettered tyres, any displacement of the components of the moulded pattern  
40 must be avoided.

It is an object of the present invention to provide means for moulding the sidewalls of vehicle tyres which are conventionally reinforced tyres which  
45 improve the sidewall moulding with respect to final appearance and consistency of sidewall sectional shape.

According to one aspect of the present invention a method of assembling a vehicle tyre comprises  
50 filling a pair of discrete annular tyre sidewall moulds with uncured sidewall compound, bringing the sidewall moulds into contact one either side of a preshaped reinforced green tyre carcass so as to fit the premoulded sidewalls to the carcass, positioning  
55 the assembly of sidewall moulds and tyre carcass in a tyre curing mould, curing the tyre and removing it from the curing mould and the sidewall moulds.

The sidewall moulds may be used to support or to assist in supporting the carcass for storage and  
60 handling between the sidewall fitting stage and the final curing operation. Furthermore the tyre bead regions may be engaged by and supported by extensions in the sidewall moulds.

Various methods may be used to fill the sidewall  
65 moulds with sidewall compound. A preferred

method is to wind a narrow strip of material into the mould until the cross-section is at least partially filled and then to consolidate the winding into a homogeneous filling of the mould. Alternatively a  
70 single strip of approximately the cross-section of the sidewall may be laid in a single turn into the sidewall mould and consolidated to ensure the join is flattened. Consolidation is preferably by means of a plate pressed over the mould cavity.

Another method of filling the sidewall mould is to use injection moulding. Continuous feed moulding may be used or transfer moulding in which a premeasured volume of sidewall compound is forced from a chamber into the mould cavity. The  
80 mould filling operation may fill the complete annular mould simultaneously or may fill a part of the mould and the filling head or die head is then relatively moved around the mould to produce the complete annular filling of compound.

It will be appreciated that there are no mould induced limitations on the sidewall pattern because of the ease of removal of the tyre from the separate  
85 sidewall moulds and the process is of great advantage for tyres having white or other contrasting colour sidewall markings.

In the case of contrasting coloured sidewall markings the sidewall filling process uses more than one mould filling step and because the sidewalls are not deformed during tyre shaping or during final shaping  
90 into the curing press, any significant movement of the various components is avoided.

Finally the steps of fitting the sidewalls to the green carcass and placing the carcass in the curing mould may be at the same time in the tyre building  
100 process. One sidewall and its associated mould may be placed in the main curing mould, the green carcass minus sidewalls is placed in the mould, the second sidewall and its associated mould is placed into the carcass and the mould is closed to effect  
105 curing.

According to another aspect of the present invention in a tyre assembly apparatus a pair of discrete annular tyre sidewall moulds are provided each including a continuous circular cavity having a  
110 surface profile as a female mould for the required sidewall, means for filling the cavity with uncured sidewall compound and means for positioning the sidewall moulds against the side of a preshaped tyre carcass such that the sidewalls become integral with  
115 the tyre assembly.

A preferred means for filling the cavity of a sidewall mould comprises a feed device for a narrow strip of uncured sidewall compound and means to relatively rotate the feed device and the sidewall  
120 mould such that a winding is produced to at least partially fill the mould cavity. Consolidating means, for example a mould closing plate, may also be provided to allow consolidation to form a homogeneous filling of the mould cavity. It is also  
125 possible to provide a feed device which feeds into the mould cavity a strip of material having a cross-section shaped to completely fill the annular mould cavity with a single rotation.

Alternatively the means for filling the cavity of the  
130 sidewall mould may be an injection moulding

machine having a die head engageable with the sidewall mould so that the entire sidewall cavity may be filled simultaneously. The injection machine may have a continuous material feed or be a transfer  
5 moulding machine. An alternative mould filling machine comprises an injection or transfer moulding machine which has a die head which is engageable in one part of the annular die and provided with a rotational drive to propel the die head around the  
10 annular cavity or more preferably to rotate the mould past the die head to complete filling of the cavity.

The sidewall mould preferably includes means to assist in retaining the compound in the cavity.  
15 Suitable means include open passages through the mould or spews which are shaped as retention rings at the edge of the sidewall.

The means for positioning the sidewall moulds against the sides of a preshaped tyre carcass may be  
20 integral with the carcass shaping machine or separate therefrom. In each case the positioning means is preferably mechanical means such as for example a set of cams and levers having adjustable, pre-set stops so that the degree of force applied to the  
25 carcass can be accurately set.

Further aspects of the present invention will become apparent from the following description, by way of example only of some embodiments in which:-

30 *Figure 1* is a cross-section of a part of a circular tyre mould including sidewall moulds according to the present invention;

*Figure 2* shows one method of filling a sidewall mould of *Figure 1*;

35 *Figure 3* shows a method of consolidating the filling in the tyre mould from *Figure 2*, and

*Figure 4* shows an alternative tyre filling system to that of *Figure 2*.

The tyre curing mould assembly shown in *Figure 1*  
40 is conventional and comprises a tread moulding segment 1 which is one of a series which are joined end-to-end to form the complete circular tyre tread mould. The segments 1 are mounted in the curing mould so that they are movable radially inwards and  
45 outwards to allow insertion of a green carcass and subsequent removal of the cured tyre. The interior of the tyre is pressurised and the complete tyre is heated by a curing diaphragm or curing bag (not shown) which is inflated usually by steam or hot  
50 liquid within the tyre. The sidewalls 2 and 3 are moulded by sidewall moulds 4 and 5 which are the novel feature of the present invention. The sidewall moulds 4 and 5 which carry sidewalls only as  
55 discrete components are detachable from the main mould segments 1 and the bead regions 6 are shaped by clip rings 7 and 8.

As shown in *Figure 2* a sidewall mould 4 comprises an annular ring which has one of its end surfaces  
60 plain and the other end face 10 is shaped to provide a female mould cavity 11 for the required tyre sidewall which is made in and carried by the sidewall mould. The mould cavity 11 includes the sidewall pattern, identification markings and Trade Marks. Either side of the mould cavity 11 there are  
65 smooth, unpatterned, circular mould sealing sur-

faces 12 and 13.

One method of filling the sidewall mould cavity 11 is shown in *Figure 2*. The sidewall mould 4 is mounted horizontally so that it may be rotated about  
70 an axis 14 beneath a tyre sidewall compound supply device 15. The compound supply device 15 comprises a hopper 16 and an extrusion head 17 and a feed tube 18. The supply device 15 provides a narrow rectangular section extrudate 19 of tyre compound  
75 and the feed tube is arranged so that the strip 19 is laid into the mould cavity 11. The mould 4 is rotated so that the strip 19 is wound around within the annular mould cavity until the cavity is filled by the winding. Means, not shown, are provided to move  
80 the feed tube 18 from side-to-side of the mould cavity, i.e. in the radial direction of the mould 11, so that the winding of the strip 19 fills the cavity to a level slightly higher than that required for the sidewall section. It should be appreciated that the  
85 arrangement is schematic and the extrusion head 17 need not be immediately above the mould as shown but can be remote with a carrying system of guides for the strip 19 of material.

*Figure 3* shows a second stage in the mould filling  
90 process which comprises bringing a consolidation plate 20 into contact with the top surface of the winding so as to consolidate the winding into a homogeneous mass having the desired cross-section. The plate 20 is conveniently provided in the  
95 same machine as the filling device 15 and is pressed against the rotatably mounted tread mould so as to completely enclose the sidewall being moulded except for small air release passages.

An alternative mould cavity filling device is shown  
100 in *Figure 4* and comprises a ring-shaped extrusion die head 21 having mating sealing surfaces to engage the mould sealing surfaces 12 and 13 and it is engaged with the sidewall mould 4 so as to define the filling sidewall mould cavity. The die head 21  
105 includes feed ports 22 to feed extrusion material to the cavity 11 and a source of pressurised compound, not shown, is connected to the feed ports 22. The sidewall mould 4 also includes narrow grooves 23 and 24 one of which extends around the inner edge  
110 of the mould cavity 11 and the other extends around the outer edge. These grooves provide re-entrant portions for the mould edges.

Both methods produce a filling for the mould cavity 11 in the required shape for the sidewall and  
115 may optionally include in addition spews of material at the edges which are engaged in the narrow grooves 17 and 18. These are not essential but are preferred particularly in the case of the second filling method when an extrusion die is used and as the die  
120 head 21 is removed from the mould cavity 11 sticking of the material of the sidewall to the surface 25 can occur. Two sidewalls are formed one in each of a pair of moulds 4 and 5 and these are then taken to a tyre shaping machine and loaded one at either  
125 side of the machine in the manner conventional for bead hoops. At the appropriate time in the tyre building operation when the tyre carcass has been shaped and the tread rubber fitted the sidewall moulds are moved axially inwards to fit the tyre  
130 sidewalls to the carcass and complete the tyre

assembly.

The tyre is then carried by means of the sidewall moulds 4 and 5 to the curing press where the moulds 4 and 5 are put in the press with the tyre as shown in Figure 1 and previously explained. After curing the sidewall moulds 4 and 5 are removed and the spews are cut off.

If desired the sidewall moulds 4 and 5 may be attached to the green carcass at the moulding stage in which case the green carcass is assembled prior to moulding without sidewalls.

When white sidewalls or white sidewall lettering is required these may be moulded into the sidewall mould by using a different die head 14 to position the white compound as required and then a second stage of injection moulding to form the remainder of the sidewall cross-section in normal black sidewall compound.

An important advantage of the present invention is that it may be applied to otherwise conventional tyre building processes changing only the time at which the sidewalls are fitted from before shaping to after shaping.

## 25 CLAIMS

1. A method of assembling a vehicle tyre comprising filling a pair of discrete annular tyre sidewall moulds with uncured sidewall compound, bringing the sidewall moulds into contact one either side of preshaped green tyre carcass so as to fit the premoulded sidewalls to the carcass, positioning the assembly of sidewall moulds and tyre carcass in a tyre curing mould, curing the tyre and removing it from the curing mould and the sidewall moulds.

2. A method of assembling a tyre according to Claim 1 wherein such sidewall mould is filled with sidewall compound by transfer moulding.

3. A method of assembling a tyre according to Claim 1 wherein each sidewall mould is filled with sidewall compound by winding a strip of material into the mould until the cross-section is at least partially filled and then consolidating the winding into a homogeneous mass.

4. A method of assembling a tyre according to Claim 1 wherein each sidewall mould is filled with sidewall compound by means of laying a single strip of approximately the cross-section of the sidewall in a single turn into the mould.

5. A method of assembling a tyre according to Claim 1, 2, 3 or 4 wherein the sidewall mould after filling has the sidewall compound consolidated by means of a mould closure plate which is pressed against the filled mould.

6. A tyre assembly apparatus comprising a pair of discrete annular tyre sidewall moulds each including a continuous circular cavity having a surface profiled as a female mould for the required sidewall, means for filling the cavity with uncured sidewall compound and means for positioning the sidewall mould against the sides of a preshaped tyre carcass such that the sidewalls become integral with the tyre assembly.

7. A tyre assembly apparatus according to Claim 6 wherein the means for filling the cavity comprises

a feed device for a strip of uncured sidewall compound and means to relatively rotate the feed device and the sidewall mould such that a winding may be laid into the cavity.

8. A method of assembling a tyre substantially as described herein and in conjunction with the attached diagrammatic drawings.

9. A tyre assembly apparatus constructed and arranged substantially as described herein with reference to the accompanying drawings.

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